

**CLAIMS****1. An articulated dump truck vehicle, including:**

a front tractor part connected to an associated rear trailer part by means of an articulated coupling which is mounted between a rear end of the tractor part and a front end of the trailer part,

said articulated coupling being operable to allow the front tractor part and the rear trailer part to rotate relative to each other about a first vertical axis, with steering means for turning the front tractor part relative to the rear trailer part about said first vertical axis for steering the vehicle, and said articulated coupling also allowing the front tractor part and the rear trailer part to rotate relative to each other about a second longitudinal axis of the vehicle,

the front tractor part having a front chassis, a pair of front wheels being mounted by a front suspension assembly on the front chassis,

a prime mover mounted on said front tractor part and driveably connected to at least one pair of wheels on the vehicle,

a vehicle driving station on said front tractor part with controls for vehicle drive and steering,

the rear trailer part having a rear chassis, at least two pairs of rear wheels mounted by a rear suspension assembly on the rear chassis,

a tipping container pivotally mounted on said rear trailer part with means for moving said tipping container on the rear chassis between a normally lowered load carrying position on the rear chassis and an inclined load tipping position on the rear chassis,

characterised in that the front suspension assembly includes an independent suspension system for mounting the pair of front wheels on the

- 19 -

front chassis of the front tractor part.

2. An articulated dump truck as claimed in claim 1 wherein said front suspension assembly is an independent suspension module mounted on the front chassis.
3. An articulated dump truck as claimed in claim 2 wherein said independent suspension module includes an axle housing with means for attachment to the front chassis, the two front wheels being pivotally mounted at opposite sides of said axle housing for vertical movement, each front wheel being mounted by one or more suspension arms on the axle housing, each suspension arm being pivotally connected to the axle housing and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the wheel on the axle housing, and spring means mounted between a suspension arm or the wheel carrier and the front chassis to resist vertical wheel movement.
4. An articulated dump truck as claimed in claim 3 wherein a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension arm which are vertically spaced-apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the axle housing and the outer end of each suspension arm being pivotally connected to the wheel carrier.
5. An articulated dump truck as claimed in any preceding claim wherein the front suspension assembly includes a suspension unit for each front wheel, said suspension unit having one or more suspension arms, each suspension arm being pivotally connected to the front chassis and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the front wheel on the front chassis, and spring means mounted between a suspension arm or the wheel carrier and the front chassis to resist vertical wheel movement.
6. An articulated dump truck as claimed in claim 5 wherein a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension

- 20 -

arm which are vertically spaced-apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the front chassis and the outer end of each suspension arm being pivotally connected to the wheel carrier.

7. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a coil spring.
8. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a pair of coil springs each having a lower end pivotally connected to the lower suspension arm and an upper end connected to the front chassis, the upper suspension arm extending between said pair of coil springs.
9. An articulated dump truck as claimed in any preceding claim wherein an associated damper is provided with each spring.
10. An articulated dump truck as claimed in any preceding claim wherein each spring includes a coil spring and associated damper housed within the spring and mounted between a lower mounting bracket and an upper mounting plate, the lower mounting bracket having a spring holder with downwardly extending forked arms which engage the lower control arm by means of a pivot pin, the upper mounting plate being secured by bolts to the front chassis.
11. An articulated dump truck as claimed in any preceding claim wherein a top of the axle housing is bolted to an underside of the front chassis.
12. An articulated dump truck as claimed in any preceding claim wherein the front chassis includes a pair of spaced-apart longitudinal members interconnected by cross members, the axle housing being bolted to an underside of cross members between the longitudinal members.
13. An articulated dump truck as claimed in any preceding claim wherein pivot pins

- 21 -

are provided at each end of the control arms which rotatably engage in complementary pivot blocks mounted on the wheel carrier, on the axle housing or on the front chassis.

14. An articulated dump truck as claimed in any preceding claim wherein the upper suspension arm is I-shaped having a pair of laterally extending pivot pins at each end which project forwardly and rearwardly of the upper suspension arm to rotatably engage the pivot blocks.
15. An articulated dump truck as claimed in any preceding claim wherein the lower suspension arm is of wishbone construction and has a pair of laterally extending pivot pins at an outer end which project forwardly and rearwardly of the lower suspension arm to rotatably engage associated pivot blocks on the wheel carrier, inwardly extending fork arms of the lower suspension arm each having at their inner end a laterally extending pivot pin which rotatably engages an associated pivot block on the axle housing or front chassis.
16. An articulated dump truck as in any preceding claim wherein said tipping load container does not extend substantially over the steer axis so that the centre of gravity of the loaded container is normally between the axes of rotation of the rear wheels or only slightly in front of the axle closest to the steer axis
17. An articulated dump truck as in any preceding claim in which an anti-roll bar is fitted to the front independent suspension.
18. An articulated dump truck as in any preceding claim in which the front wheels are steerable on the front chassis.
19. An articulated dump truck as claimed in claim 18 which includes sensing means to measure one or more of the vehicle speed and the steer angles of the front wheels and of the articulation joint and control means to apportion steering action between the said front wheels and the articulation joint.

- 22 -

20. An articulated dump truck as claimed in claim 18 in which articulation around the vertical steering axis may be locked.
21. An articulated dump truck as claimed in claim 18 in which the front wheel steering may be locked.
22. An articulated dump truck as claimed in any preceding claim that includes a motion control system having means for controlling operation of the vehicle suspension system in response to pitch, roll or yaw movement of the vehicle.
23. An articulated dump truck as in claim 22 wherein said means controls operation of the tractor suspension system in response to pitch, roll or yaw movement of the vehicle.
24. An articulated dump truck as claimed in any preceding claim including a roll control system having means for controlling operation of the vehicle suspension system in response to roll of the vehicle.
25. An articulated dump truck as claimed in claim 24 wherein said means controls operation of the tractor suspension system in response to roll of the tractor unit.
26. An articulated dump truck as claimed in claims 24 or 25 wherein the roll control system includes means for stiffening the suspension in direct proportion to the amount of roll.
27. An articulated dump truck as claimed in any preceding claim which includes means for locking the suspension when a preset roll angle is reached.
28. An articulated dump truck as claimed in any preceding claim wherein the roll control system includes means for controlling operation of the suspension system in response to the sensed turn angle between the tractor and the trailer.

- 23 -

29. An articulated dump truck as claimed in any preceding claim wherein the roll control system includes means for sensing turning of the tractor unit relative to the trailer unit and suspension locking means operably connected to the sensing means to lock the suspension when a preset turn angle is reached, and release the suspension for normal operation below said preset turn angle.

30. An articulated dump truck vehicle, including:

a front tractor part connected to an associated rear trailer part by means of an articulated coupling which is mounted between a rear end of the tractor part and a front end of the trailer part,

said articulated coupling being operable to allow the front tractor part and the rear trailer part to rotate relative to each other about a first vertical axis, with steering means for turning the front tractor part relative to the rear trailer part about said first vertical axis for steering the vehicle, and said articulated coupling also allowing the front tractor part and the rear trailer part to rotate relative to each other about a second longitudinal axis of the vehicle,

the front tractor part having a front chassis, a pair of front wheels being mounted by a front suspension assembly on the front chassis,

a prime mover mounted on said front tractor part and driveably connected to at least one pair of wheels on the vehicle,

a vehicle driving station on said front tractor part with controls for vehicle drive and steering,

the rear trailer part having a rear chassis, at least two pairs of rear wheels mounted by a rear suspension assembly on the rear chassis,

a tipping container pivotally mounted on said rear trailer part with

- 24 -

means for moving said tipping container on the rear chassis between a normally lowered load carrying position on the rear chassis and an inclined load tipping position on the rear chassis,

characterised in that the front suspension assembly includes an independent suspension system for mounting the pair of front wheels on the front chassis of the front tractor part, said front suspension assembly being an independent suspension module mounted on the front chassis.

31. An articulated dump truck as claimed in claim 30 wherein said independent suspension module includes an axle housing with means for attachment to the front chassis, the two front wheels being pivotally mounted at opposite sides of said axle housing for vertical movement, each front wheel being mounted by one or more suspension arms on the axle housing, each suspension arm being pivotally connected to the axle housing and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the wheel on the axle housing, and spring means mounted between a suspension arm or the wheel carrier and the front chassis to resist vertical wheel movement.
32. An articulated dump truck as claimed in claim 31 wherein a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension arm which are vertically spaced-apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the axle housing and the outer end of each suspension arm being pivotally connected to the wheel carrier.
33. An articulated dump truck as claimed in of claims 30 to 32 wherein the front suspension assembly includes a suspension unit for each front wheel, said suspension unit having one or more suspension arms, each suspension arm being pivotally connected to the front chassis and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the front wheel on the front chassis, and spring means mounted between a suspension

- 25 -

arm or the wheel carrier and the front chassis to resist vertical wheel movement.

34. An articulated dump truck as claimed in claim 33 wherein a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension arm which are vertically spaced-apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the front chassis and the outer end of each suspension arm being pivotally connected to the wheel carrier.
35. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a coil spring.
36. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a pair of coil springs each having a lower end pivotally connected to the lower suspension arm and an upper end connected to the front chassis, the upper suspension arm extending between said pair of coil springs.
37. An articulated dump truck vehicle, including:
  - a front tractor part connected to an associated rear trailer part by means of an articulated coupling which is mounted between a rear end of the tractor part and a front end of the trailer part,
  - said articulated coupling being operable to allow the front tractor part and the rear trailer part to rotate relative to each other about a first vertical axis, with steering means for turning the front tractor part relative to the rear trailer part about said first vertical axis for steering the vehicle, and said articulated coupling also allowing the front tractor part and the rear trailer part to rotate relative to each other about a second longitudinal axis of the vehicle,



- 26 -

the front tractor part having a front chassis, a pair of front wheels being mounted by a front suspension assembly on the front chassis,

a prime mover mounted on said front tractor part and driveably connected to at least one pair of wheels on the vehicle,

a vehicle driving station on said front tractor part with controls for vehicle drive and steering,

the rear trailer part having a rear chassis, at least two pairs of rear wheels mounted by a rear suspension assembly on the rear chassis,

a tipping container pivotally mounted on said rear trailer part with means for moving said tipping container on the rear chassis between a normally lowered load carrying position on the rear chassis and an inclined load tipping position on the rear chassis,

characterised in that the front suspension assembly includes an independent suspension system for mounting the pair of front wheels on the front chassis of the front tractor part, said front suspension assembly being an independent suspension module mounted on the front chassis, said independent suspension module including an axle housing with means for attachment to the front chassis, the two front wheels being pivotally mounted at opposite sides of said axle housing for vertical movement, each front wheel being mounted by one or more suspension arms on the axle housing, each suspension arm being pivotally connected to the axle housing and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the wheel on the axle housing, and spring means mounted between a suspension arm or the wheel carrier and the front chassis to resist vertical wheel movement.

38. An articulated dump truck as claimed in claim 37 wherein a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension

- 27 -

arm which are vertically spaced apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the axle housing and the outer end of each suspension arm being pivotally connected to the wheel carrier.

39. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a coil spring.
40. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a pair of coil springs each having a lower end pivotally connected to the lower suspension arm and an upper end connected to the front chassis, the upper suspension arm extending between said pair of coil springs.

41. An articulated dump truck vehicle, including:

a front tractor part connected to an associated rear trailer part by means of an articulated coupling which is mounted between a rear end of the tractor part and a front end of the trailer part,

said articulated coupling being operable to allow the front tractor part and the rear trailer part to rotate relative to each other about a first vertical axis, with steering means for turning the front tractor part relative to the rear trailer part about said first vertical axis for steering the vehicle, and said articulated coupling also allowing the front tractor part and the rear trailer part to rotate relative to each other about a second longitudinal axis of the vehicle,

the front tractor part having a front chassis, a pair of front wheels being mounted by a front suspension assembly on the front chassis,

a prime mover mounted on said front tractor part and driveably connected to at least one pair of wheels on the vehicle,

- 28 -

a vehicle driving station on said front tractor part with controls for vehicle drive and steering,

the rear trailer part having a rear chassis, at least two pairs of rear wheels mounted by a rear suspension assembly on the rear chassis,

a tipping container pivotally mounted on said rear trailer part with means for moving said tipping container on the rear chassis between a normally lowered load carrying position on the rear chassis and an inclined load tipping position on the rear chassis,

characterised in that the front suspension assembly includes an independent suspension system for mounting the pair of front wheels on the front chassis of the front tractor part, the front suspension assembly includes a suspension unit for each front wheel, said suspension unit having one or more suspension arms, each suspension arm being pivotally connected to the front chassis and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the front wheel on the front chassis, and spring means mounted between a suspension arm or the wheel carrier and the front chassis to resist vertical wheel movement.

42. An articulated dump truck as claimed in claim 41 wherein a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension arm which are vertically spaced-apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the front chassis and the outer end of each suspension arm being pivotally connected to the wheel carrier.
43. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a coil spring.

- 29 -

44. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a pair of coil springs each having a lower end pivotally connected to the lower suspension arm and an upper end connected to the front chassis, the upper suspension arm extending between said pair of coil springs.
45. An articulated dump truck vehicle, including:
- a front tractor part connected to an associated rear trailer part by means of an articulated coupling which is mounted between a rear end of the tractor part and a front end of the trailer part,
  - said articulated coupling being operable to allow the front tractor part and the rear trailer part to rotate relative to each other about a first vertical axis, with steering means for turning the front tractor part relative to the rear trailer part about said first vertical axis for steering the vehicle, and said articulated coupling also allowing the front tractor part and the rear trailer part to rotate relative to each other about a second longitudinal axis of the vehicle,
  - the front tractor part having a front chassis, a pair of front wheels being mounted by a front suspension assembly on the front chassis,
  - a prime mover mounted on said front tractor part and driveably connected to at least one pair of wheels on the vehicle,
  - a vehicle driving station on said front tractor part with controls for vehicle drive and steering,
  - the rear trailer part having a rear chassis, at least two pairs of rear wheels mounted by a rear suspension assembly on the rear chassis,
  - a tipping container pivotally mounted on said rear trailer part with means for moving said tipping container on the rear chassis between a

- 30 -

normally lowered load carrying position on the rear chassis and an inclined load tipping position on the rear chassis,

characterised in that the front suspension assembly includes an independent suspension system for mounting the pair of front wheels on the front chassis of the front tractor part, the front suspension assembly includes a suspension unit for each front wheel, said suspension unit having one or more suspension arms, each suspension arm being pivotally connected to the front chassis and to a wheel carrier on which the front wheel is rotatably mounted to allow vertical movement of the front wheel on the front chassis, and spring means mounted between a suspension arm or the wheel carrier and the front chassis to resist vertical wheel movement, a pair of suspension arms are provided, namely an upper suspension arm and a lower suspension arm which are vertically spaced-apart, each of the upper suspension arm and the lower suspension arm having an inner end and an outer end, the inner end of each suspension arm being pivotally connected to the front chassis and the outer end of each suspension arm being pivotally connected to the wheel carrier.

46. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a coil spring. .
47. An articulated dump truck as claimed in any preceding claim wherein the spring means includes a pair of coil springs each having a lower end pivotally connected to the lower suspension arm and an upper end connected to the front chassis, the upper suspension arm extending between said pair of coil springs.